



We maximize America's Sea Power by applying relevant oceanographic knowledge across the full spectrum of warfare.

***Naval Oceanographic Office
Mission Statement***

For more than 170 years, NAVOCEANO has provided tactical environmental information and services to the U.S. Navy. By providing documentation, analysis, databases and data processing, NAVOCEANO serves the mission of the warfighter. A key to this success has been our ability to adapt to meet the dynamic needs of the warfighter.

The Department of Defense (DoD) is currently undergoing a transformation to a new Net-Centric architecture that takes advantage of Web-based technologies in order to maintain warfighters' information superiority on the changing battle spaces of today's world. The key objectives of the DoD Net-Centric strategy are (1) ensuring that tactical data are visible, available and usable to accelerate decision making; (2) tagging all data with metadata (data about data) to facilitate data discovery by users; (3) posting all data to shared spaces to provide access to all users except when limited by security, policy or regulations; and (4) advancing the DoD interoperability from point-to-point interfaces to enable many-to-many data exchanges.

A major contributor to the DoD's ability to more rapidly plan and execute operations is the increasing use of Information Management and Information Technology (IM/IT). Environmental databases and environmental prediction systems must be easily accessible to our customers through state-of-the-art IM/IT systems. To meet this challenge, NAVOCEANO has endeavored to become fully integrated in the Navy Marine Corps Portal (NMCP), FORCENet and a full participant in Net-Centric Warfare. Web services are crucial to the effective transfer of tactical data and increased system functionality.

NAVOCEANO's Strategic Plan includes objectives such as: (1) developing methods of employing NAVOCEANO assets to im-

pact operational time scales; and (2) assuring responsiveness and impact to operational needs. Migration to Web services is one way to achieve these objectives, making the vast amount of data, information, and oceanographic knowledge at NAVOCEANO visible in the Net-Centric Warfare arena.

What is a Web service?

A Web service, according to the World Wide Web Consortium, is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format called WSDL or Web Service Definition Language. Other systems interact with the Web service in a manner prescribed by its description using Simple Object Access Protocol or SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards. A Web service allows the free exchange of data and functionality between Web-based applications, thereby providing data and support to users. The result is faster delivery of accurate, more consistent information for the user.

The NAVOCEANO Web Services Working Group (NWSWG) was established in 2003 to begin the transformation process to Net-Centric Warfare. The NWSWG is chartered to develop Web services for NAVOCEANO environmental models, databases and software applications. The NWSWG provides a focal point for NAVOCEANO's efforts to develop robust Web Services in support of Net-Centric Warfare. When these Web services are fully established, NAVOCEANO will be able to provide relevant data and analysis to the warfighter, allowing the warfighter to exploit environmental advantages or mitigate environmental problems, thus bringing power to the edge.

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The heart of NAVOCEANO Web Services is the Joint Meteorology and Oceanography (METOC) Data Services Framework (JMDSF). Early in the development of Web Services, NAVOCEANO realized the need for a framework that would unify all the services. This framework would allow one service to call or interact with another service, which meant there had to be a way to share data in a consistent manner. In order to provide robust support, this framework is based on the Joint METOC Broker Language (JMBL), which is based upon the Joint METOC Conceptual Data Model (JMCDM).

The JMDSF is a robust toolkit for deploying data-oriented services (DOS) to securely deliver geospatial information consistent with the JMBL specification. These enterprise services facilitate deployment of data-oriented services to computers linked together by a proxy server. The framework provides services for analyzing JMBL requests, determining the best data-oriented services for answering them, passing requests to data-oriented services, collecting responses with return values, and returning the results to the requester. The JMDSF will be the key to establishing a single access point for all METOC data.

The Joint METOC Interoperability Board (JMIB), chartered by the Navy and Air Force, was tasked with addressing interoperability issues.

Why JMBL?

Joint military operations often reveal a lack of interoperability between Navy and U.S. Air Force METOC systems. The JMCDM, a logical data model, was created in 1995 to integrate the geophysical data requirements of all DoD components. The JMCDM and its supporting encyclopedia are a subset of the DoD Enterprise Data Model. The Joint METOC Interoperability Board (JMIB), chartered by the Navy and Air Force, was tasked with addressing interoperability issues. The Data Standards Working Group, chartered by JMIB, established the JMBL. The JMBL schema provides an XML representation of the JMCDM and establishes a single interface for requesting and retrieving METOC data.

NAVOCEANO is establishing a data service layer, a business logic layer, a tool set layer, and an application/User Facing Service layer that use the JMDSF as the backbone to tie them all together. All development is J2EE compliant and uses the standard Web services protocols such as XML, SOAP, etc. This simplifies the integration and deployment of new services and applications.

The primary objective is to meet the needs of the warfighter. Getting relevant information to the warfighter within the time constraints of the decision cycle is critical. Current data systems may require a warfighter to visit two or three different sites to get three or four different sets of information that still need to be processed to get the final answer. Processing may be complicated if the data sets are all in different or incompatible formats, as is too often the case.

Each data set has its own interface that the warfighter needs to learn and understand how to use. The warfighter must know in advance where the information resides. Any new information or tools that may have become available after the predeployment training took place are effectively not available. These issues are by themselves difficult to resolve, but when they are all piled together, the proverbial needle in the haystack scenario comes to mind.

How does the JMDSF help solve these issues?

The JMDSF provides the warfighter with a single interface that can access all METOC data and information. This JMDSF is responsible for recording where the actual authoritative data resides, relieving the warfighter of this concern. Because the JMDSF is built upon the JMBL standard, which is also being adopted by the Air Force, it can access all METOC data. This single interface also simplifies training the warfighter (one interface to all the data and information).

Information is returned in a single standard JMBL-formatted response. The data can be sent directly to the requester in several different formats (using transformation services), not just the native format of the database, or the requester can view and overlay multiple data sets (using mapping and plotting services). This approach greatly reduces formatting issues that occur when

trying to manipulate multiple data sets. The warfighter requires only a Web browser to access data from Web Services. No additional software or plug-ins are required. All METOC data and services integrated into the framework can now be accessed from anywhere — power to the edge.

The same standards within the JMDSF that benefit the warfighter help make the software developer's task easier. The JMDSF provides a robust toolkit with application program interfaces (APIs) that allow Tactical Decision Aid (TDA) developers to tie into multiple data sets using the same standard JMBL request and response structures. The TDA developer can send a single request to a single interface to get multiple data sets that may reside in several different places, using Web services standard protocols. Again, the Web services response always employs the same standard JMBL structure. This procedure greatly reduces the development time for integrating new data sets.

Having Web services integrated into the JMDSF allows developers to reuse different Web services instead of having to write a new application each time.

Having Web services integrated into the JMDSF allows developers to reuse different Web services instead of having to write a new application each time. The theory of software developers employing a common environment for reusing program code has not been embraced by many, as industry had anticipated. Software developers have not been comfortable with this scenario. The difference is that reusing a Web service does not equate to having to place lines of someone else's code into an application and hoping it will work. The service being reused has already been tested and is operational in the environment the developer needs. The comfort level of using a Web service that has already been proven to work is much greater.

As a case in point, NAVOCEANO has integrated a new map service into a legacy application. This same map service is also being integrated into several other Web services currently in development. This has dramatically reduced development time for new Web services, as well as allowed NAVOCEANO to tie in some legacy applications. In the past, data providers have had to focus on several issues, such as data collection, quality control, data storage management and a means for the end user to retrieve data.

The retrieval method could be as simple as a File Transfer Protocol (FTP) push or as intricate as a Graphical User Interface (GUI). Data providers were responsible for end-to-end delivery of their data. Of course, different customers wanted data in different formats and resolutions, depending on their needs. Data providers had to store data in many different formats and sometimes provided several different GUIs for different customers.

The JMDSF provides tools to help data providers integrate their data sets into the framework. For some data formats, the API

is already written, and only some configuration settings are required to integrate the data set into the framework. In other cases, the provider may need to prepare a data extractor, which can be tied into the framework as a data handler. Once the data handler is integrated into the JMDSF, it inherits the interoperability of JMBL.

Also, there is a built-in delivery mechanism that will allow an end user to acquire data using Web services. The data provider does not have to know anything about Web services to receive this benefit.

Other services and software applications can be called to display, transform, plot and even overlay the data. The data provider need only be concerned with maintaining the data in one format and keeping it as current and up-to-date as possible. They can focus on what they do best and allow the framework to provide customer support services.

NAVOCEANO Web Services will be comprised of the following Application Services:

- Catalog Services
- Data Transformation Services
- Data-Oriented Services (DOS)
- Joint Meteorology and Oceanography (METOC) Data Services Framework (JMDSF) Map Services
- Model/Algorithm Services
- Plotting Services
- Request For Product (RFP) Services
- Security Services

A single Web application may access several Web services after being accessed by the user.

Application services will be comprised of Web applications and utilities from the Geophysics Fleet Mission Program Library (GF MPL). Already completed and online are METOC Product and Services Catalog; Solar/Lunar Almanac Predictions (SLAP); Surf Forecasting (SURF); Tidal Predictions (TIDES); Wind Conversion; Pressure Altitude/Density Altitude (PADA), Pilot Balloon (PIBAL); Temperature Utility (TEMP UTIL); and Unit Conversion. Services for the Navy's Oceanographic and Atmospheric Master Library (OAML) and various modeling/forecasting data assets are available now.

A number of enhancements are planned for NAVOCEANO Web Services, which include ingest capabilities for near-real-time acoustic data in support of Anti-Submarine Warfare (ASW) and Mine Warfare (MIW). A new METOC Product and Services Catalog is in development that will provide discovery, visualization and acquisition of all METOC products and services integrated in the JMDSF. The Global Ocean Data Environmental Support Service (GODESS) and a data archiving service will also be provided.

What does the future hold?

NAVOCEANO is currently working with the Air Force Weather Agency, Fleet Numerical Meteorology and Oceanography Cen-

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In the future, architectures will change from request/response to event driven. Messaging systems will become smart enough to send messages to different Web services based on content. As data directly affecting the battle space changes, Tactical Decision Aids and other decision aids will be updated automatically. There are already indications of this occurring in industry with the arrival of the Enterprise Service Bus and the Event Driven Architectures.

In order for the Navy to benefit from these emerging technologies, a firm foundation must be laid. Adoption of Web services, a common data exchange format, and an adaptable framework to support these technologies provides such a foundation. The result will be integration of environmental data into on-scene decision aids, within the bounds of the tactical decision cycle. The warfighter will get the answer, when and where it is needed.

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